CLAIMS

What is claimed is:

1.   A color registration control method of an image forming apparatus, the method comprising:

developing a registration pattern with predetermined colors by overlapping a left-half pattern and a right-half pattern of a second pattern, and a left-half pattern and a right-half pattern of a first pattern, which are arranged symmetrically to a center, respectively, in a scanning direction;

detecting density information of the left-half pattern and the right-half pattern of the registration pattern by using a first and a second density sensor, and sending the detected information to a comparator;

calculating a color registration error in the comparator by comparing the density of the left-half pattern with the density of the right-half pattern; and

outputting a color registration control signal in the control unit in response to an error signal received by the comparator.

2.   A color registration control method of an image forming apparatus, the method comprising:

arranging a left-half and a right-half of a first pattern, which are arranged symmetrically to a center, on a top side and on a bottom side, respectively, and putting a left-half pattern and a right-half pattern of a second pattern, which are arranged, on the left-half pattern and the right-half pattern of the first pattern, respectively, in a scanning direction, thereby developing a registration pattern with predetermined colors;

detecting density information of the left-half pattern and the right-half pattern of the registration pattern by using a first and a second density sensor, and sending the detected information to a comparator;

calculating a color registration error by comparing the density of the left-half pattern with the density of the right-half pattern in the comparator; and

outputting from a control unit a color registration control signal in response to an error signal received by the comparator.

3. The method of claim 1, wherein in the first and second patterns, an identical bit line is developed on an identical location.

4. The method of claim 1, wherein the first and second patterns comprise bit lines, wherein each of the bit lines is a multiple of 2 and is arranged in a sub-scanning direction.

5. The method of claim 1, wherein the first and second patterns comprise 2-, 4-, 8-, 16-, and 32-bit lines that are arranged in a sub-scanning direction.

6. The method of claim 1, wherein in the calculating a color registration error, if a density difference between the left-half and the right-half is equal to or greater than a reference value, one of the left-half and the right-half is set to a first binary number, and the other is set to a second binary number, and if a density difference between the left-half and the right-half is less than the reference value, determination is held back and a density detection table is calculated.

7. The method of claim 1, wherein in the outputting a color registration control signal, if an error occurs, the color registration control signal is output and the method further comprises developing again the registration pattern with predetermined colors by overlapping the left-half pattern and the right-half pattern of the second pattern, and the left-half pattern and the right-half pattern of the first pattern, which are arranged symmetrically to the center, respectively, in the scanning direction.

8. The method of claim 1, wherein in the outputting a color registration control signal, if the error does not occur, a current color registration control process is finished and the method for controlling the color registration of the image forming apparatus is repeatedly performed for other color registration control.

9. The method of claim 1, wherein in the outputting a color registration control signal, the control unit outputs a signal controlling a laser scanning unit of a developer and a belt steering apparatus.

10.   A color registration control method of an image forming apparatus, the method comprising:

developing a registration pattern with predetermined colors by overlapping a left-half pattern and a right-half pattern of a second pattern, which have a predetermined bit line difference to each other in a sub-scanning direction, and a left-half pattern and a right-half pattern of a first pattern, which are arranged symmetrically to a center, respectively, in a scanning direction;

detecting density information of the left-half pattern and the right-half pattern of the registration pattern by using a first and a second density sensor, and sending the detected information to a comparator;

calculating a color registration error by comparing the density of the left-half pattern with the density of the right-half pattern in the comparator; and

outputting from a control unit a color registration control signal according to the error signal received by the comparator.

11.   A color registration control method of an image forming apparatus, the method comprising:

arranging a left-half and a right-half of a first pattern, which are arranged identically to a center, on a top side and on a bottom side, respectively, and putting a left-half pattern and a right-half pattern of a second pattern, which have a predetermined bit line difference to each other in a sub-scanning direction, on the left-half pattern and the right-half pattern of the first pattern, respectively, in a scanning direction, thereby developing a registration pattern with predetermined colors;

detecting density information of the left-half pattern and the right-half pattern of the registration pattern by using a first and a second density sensor, and sending the detected information to a comparator;

calculating a color registration error by comparing the density of the left-half pattern with the density of the right-half pattern in the comparator; and

outputting from a control unit a color registration control signal in response to the error signal received by the comparator.

12.   The method of claim 10, wherein in the first and second patterns, an identical bit line is developed on an identical location.

13. The method of claim 10, wherein the first and second patterns comprise bit lines, wherein each of the bit lines is a multiple of 2 and is arranged in a sub-scanning direction.

14. The method of claim 10, wherein the first and second patterns comprise 2-, 4-, 8-, 16-, and 32-bit lines that are arranged in a sub-scanning direction.

15. The method of claim 10, wherein in the calculating a color registration error, if a density difference between the left-half and the right-half is equal to or greater than a reference value, one of the left-half and the right-half is set to a first binary number, and the other is set to a second binary number, and if a density difference between the left-half and the right-half is less than the reference value, determination is held back, and by doing so, a density detection table is calculated.

16. The method of claim 10, wherein in the outputting a color registration control signal, if an error occurs, the color registration control signal is output and the method further comprises developing again a registration pattern with predetermined colors by overlapping a left-half pattern and a right-half pattern of a second pattern, which have a predetermined bit line difference to each other in a sub-scanning direction, and a left-half pattern and a right-half pattern of a first pattern, which are arranged symmetrically to a center, respectively, in a scanning direction.

17. The method of claim 10, wherein in the outputting a color registration control signal, if the error does not occur, a current color registration control process is finished and the method for controlling the color registration of the image forming apparatus is repeatedly performed for other color registration control.

18. The method of claim 10, wherein in the outputting a color registration control signal, the control unit outputs a signal controlling a laser scanning unit of a developer and a belt steering apparatus.

19. A color registration control method of an image forming apparatus, the method comprising:

developing at least one registration pattern with predetermined colors;

detecting density information of a first half and a second half of the registration pattern;

calculating a registration error by comparing the density of the first half and the second half of the registration pattern;

outputting a registration control signal in response to an error signal received so that registration can be controlled through a modified registration control signal.

20.   The color registration control method of claim 19, wherein the developing the registration pattern comprises:

arranging a first half and a second half of a first pattern and a second pattern, symmetrically to a center, respectively, in a scanning direction; and

putting the first half and the second half of the first pattern on top of the first half and the second half of the second pattern, respectively; in order to develop the registration pattern.

21.   The color registration control method of claim 20, further comprising arranging at least one bit line of each of the first and second patterns in a sub-scanning direction, wherein each bit line is a multiple of 2.

22.   The color registration control method of claim 20, further comprising arranging at least a 2-, 4-, 8-, 16-, and 32-bit line of the first and second pattern in a sub-scanning direction.

23.   The color registration control method of claim 20, further comprising arranging n at least one bit line of the first pattern symmetrically to the center and arranging at least one bit line of the second pattern identically in the first and the second side.

24.   The color registration control method of claim 20, further comprising arranging at least a 2-, 4-, 8-, 16-, and 32-bit line of the first pattern symmetrically to the center and arranging the second pattern in at least a 2-, 4-, 8-, 16-, and 32-bit line in the first half and the second half of the second pattern.

25.   The color registration control method of claim 20, further comprising developing the registration pattern after detecting the putting of the first half and the second half of the first pattern on top of the first half and the second half of the second pattern, respectively.

26. The color registration control method of claim 20, wherein the first half of each of the first and second patterns is a left-half side and the second half of each of the first and second patterns is a right-half side.

27. The color registration control method of claim 19, wherein the developing the registration pattern comprises:

arranging a first half and a second half of a first pattern, symmetrically to a center, on a top side and on a bottom side, respectively; and

putting a first half and a second half of a second pattern on top of the first half and the second half of the first pattern, respectively, in a scanning direction, in order to develop the registration pattern.

28. The color registration control method of claim 19, wherein the developing the registration pattern comprises:

arranging a first half and a second half of a first pattern, symmetrically to a center, respectively, in a scanning direction; and

putting a first half and a second half of a second pattern, each half having a predetermined bit line difference to each other in a sub-scanning direction, on the first half and the second half of the first pattern, respectively, in a scanning direction, in order to develop the registration pattern.

29. The color registration control method of claim 19, wherein the developing the registration pattern comprises:

arranging a first half and a second half of a first pattern symmetrically to a center, on a top side and a bottom side, respectively; and

putting a first half and a second half of a second pattern, each half having a predetermined bit line difference to each other in a sub-scanning direction, on the first half and the second half of the first pattern, respectively, in a scanning direction, in order to develop the registration pattern.

30.   The color registration control method of claim 29, further comprising arranging at least one bit line of each of the first and second patterns in a sub-scanning direction, wherein each bit line is a multiple of 2.

31.   The color registration control method of claim 29, further comprising arranging at least a 2-, 4-, 8-, 16-, and 32-bit line of the first and second pattern in a sub-scanning direction.

32.   The color registration control method of claim 29, further comprising arranging n at least one bit line of the first pattern symmetrically to the center and arranging at least one bit line of the second pattern identically in the first and the second side.

33.   The color registration control method of claim 29, further comprising arranging at least a 2-, 4-, 8-, 16-, and 32-bit line of the first pattern symmetrically to the center and arranging the second pattern in at least a 2-, 4-, 8-, 16-, and 32-bit line in the first half and the second half of the second pattern.

34.   The color registration control method of claim 29, further comprising developing the registration pattern after detecting the putting of the first half and the second half of the first pattern on top of the first half and the second half of the second pattern, respectively.

35.   The color registration control method of claim 29, wherein the first half of each of the first and second patterns is a left-half side and the second half of each of the first and second patterns is a right-half side.

36.   The color registration control method of claim 19, wherein when the registration pattern, in which the first half and the second half of each of the first and the second pattern is arranged on the top side and on the bottom side, respectively, is developed, calculating the density detection table by one density sensor.

37.   The color registration method of claim 19, further comprising calculating a density detection table when detecting the density information of the first half and the second half of the developed pattern, setting a first binary number to one of the first half and the second half if a density difference between the first half and the second half is equal to or greater than a reference value and setting a second binary number to the other half, and not setting a binary number to either half if there is no density difference between the first half and the second half.

38.   The color registration method of claim 19, further comprising calculating the registration error by obtaining a reference density table from the developed registration patterns when bit line errors occur to the first half and the second half in the reference registration pattern and storing the reference density table in the CPU, wherein after storing the reference density table in a CPU, developing a second registration pattern is developed in the image forming apparatus and comparing the densities of the first half and the second half of the second registration pattern in order to obtain the detected density table.

39.   The color registration method of claims 38, wherein by comparing the detected density table with the reference density table the number of bit lines of registration error that have occurred can be determined.

40.   The color registration method of claim 38, wherein when detecting the density information of the first half and the second half of the developed registration pattern, if there is no registration error, the registration pattern becomes a reference registration pattern corresponding to an error value of 0.

41.   The color registration control method of claim 19, further comprising:
        determining if the modified registration is accurate by repeating the method of developing the registration pattern with predetermined colors;
        detecting and comparing density information of the first half and the second half of the registration pattern;
        calculating the color registration error from the detected density information by comparing the density of the first half and the second half of the registration pattern; and
        determining whether the registration error has occurred; wherein if no error is detected, a next color registration control can be started.

42. The color registration method of claim 38, wherein if an error is detected, the density information of the first half and the second half of the developed pattern vary, respectively.

43. The color registration method of claims 36, wherein by comparing the detected density table with the reference density table the number of bit lines of registration error that have occurred can be determined.

44. A color registration control method of an image forming apparatus, the method comprising:

developing a registration pattern with predetermined colors;

detecting density information of a first half and a second half of the registration pattern;

calculating a detection density table from the detected density information in order to obtain a color registration error;

obtaining a reference density table and comparing the reference density table with the detection density table; and

determining from the comparison whether a registration error has occurred.

45. The color registration method of claim 44, further comprising correcting the registration error by outputting a color registration control signal so that registration can be controlled through a modified registration.

46. The color registration control method of claim 45, further comprising determining if the modified registration is accurate by repeating the method of developing the registration pattern with predetermined colors;

detecting and comparing density information of the first half and the second half of the registration pattern;

calculating the color registration error from the detected density information by comparing the density of the first half and the second half of the registration pattern; and

determining whether the registration error has occurred, wherein if no error is detected, a next color registration control can be started.

47.   An image forming apparatus to control a color registration error, the apparatus comprising:

a transfer belt;

at least one density sensor provided on the transfer belt to detect density information of a developed color registration pattern;

a comparator to receive a density signal detected by the at least one density sensor and output an error signal; and

a control unit for receiving the error signal from the comparator and outputting a color registration control signal.

48.   The image forming apparatus of claim 47, further comprising:

at least one amplifier to amplify the density signal received from the respective density sensor; and

at least one A/D converter to convert the respective density signal from an analog signal to a digital signal and input the digital signal to the comparator.

49.   The image forming apparatus of claim 47, wherein the at least one density sensor comprises a first and a second density sensor to detect a first density signal and a second density signal, respectively.

50.   The image forming apparatus of claim 49, wherein the first density sensor and the second density sensor each detect the density of a first half and a second half of the color registration pattern, respectively.

51.   The image forming apparatus of claim 49, wherein the first and the second density sensors are arranged substantially parallel with respect to each other in a scanning direction and are located on the intermediate transfer belt between a development roller and a transfer unit for transferring the developed image to a recording medium.

52.   The image forming apparatus of claim 49, wherein the comparator compares the first density signal and the second density signal in order to detect a density table.

53.   The image forming apparatus of claim 47, wherein when a single density sensor is used to detect the color registration pattern, each of the first patterns and each of the second patterns is divided, respectively, into a first half and a second half from the center, and arranged on the top and bottom, respectively, in the sub-scanning direction.

54.   The image forming apparatus of claim 47, wherein the first half and the second half are a left-half and a right-half, respectively.